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Green Urbanism and Diffusion Issues

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Abstract: *This paper addresses the research question, ‘What are the diffusion determinants for green urbanism innovations in Australia?’ This is a significant topic given the global movement towards green urbanism. The study reported here is based on desktop research that provides new insights through (1) synthesis of the latest research findings on green urbanism innovations and (2) interpretation of diffusion issues through our innovation system model. Although innovation determinants have been studied extensively overseas and in Australia, there is presently a gap in the literature when it comes to these determinants for green urbanism in Australia. The current paper fills this gap. Using a conceptual framework drawn from the innovation systems literature, this paper synthesises and interprets the literature to map the current state of green urbanism innovations in Australia and to analyse the drivers for, and obstacles to, their optimal diffusion.*

The results point to the importance of collaboration between project-based actors in the implementation of green urbanism. Education, training and regulation across the product system is also required to improve the cultural and technical context for implementation. The results are limited by their exploratory nature and future research is planned to quantify barriers to green urbanism.

Keywords: *Environment, innovation, diffusion, green urbanism, Australia*

INTRODUCTION

Global cities are entering a challenging period as a result of climate change, population growth, increasing levels of urbanisation and depleting natural resources. Currently, Australia is facing challenges in meeting global community obligations to reduce fossil fuel use and mitigate the effects of global warming, due to high greenhouse emission levels per capita in comparison to world standards (8). On a global scale, greenhouse gas emissions increased by 3.1% between 2000 and 2006, compared to an increase of 1.1% during the 1990’s (9). This increase reflects the urgency for change in our approach to the built environment and the need for humans to reduce resource consumption despite population growth and urbanisation. This not only involves ‘technical’ sustainability actions (such as the use of sustainable and eco-efficient materials or design features), but also ‘behavioural’ sustainability, i.e. positive human behaviour in relation to the environment (22). These two areas of action are closely interlinked and can heavily influence one another.

Australia’s population growth is expected to reach between 30.9 and 42.5 million people by 2056 (1). As a result of population growth, rapid urbanisation is significantly increasing



settlement density which can negatively affect the well-being of residents and place excessive psychological demands on them (18). This translates into unhealthy communities with higher rates of psychological problems.

The sustainable city movement or what has been coined 'green urbanism' is a concept that offers innovative approaches to dealing with rapid urban growth. A major challenge faced by planners and policy makers in Australia is understanding the complex spatial connections that define our built environment, particularly in urban areas. Thus, a coherent approach is required to integrate urban spaces across global, regional, city, precinct, building and building component levels (16). Obviously this is not an easy task, but there is an increasing need for cities across all spatially connected levels to be developed in a sustainable way.

Integrating sustainable 'green' systems into new developments is easier than retrofitting existing urban spaces and as such if 'we [industry, policy makers, communities] can influence planning of new towns right from the beginning, we have a great chance to get things right' (12). This includes designing new developments that 'can contribute both to the reduction of emissions and delivery of zero carbon development, and to the shaping of sustainable communities that are resilient to the climate change now expected as inevitable' (5).

Beatley (2) provided a significant early contribution to the Green Urbanism agenda when he noted that there are broad design characteristics that exemplify green urbanism (p6-8), in cities that:

- strive to live within their ecological limits, fundamentally reduce their ecological footprint, and acknowledge their connections with and impacts on other cities and communities and the larger planet
- are designed for and function in ways analogous to nature
- strive to achieve a circular rather than a linear metabolism, which nurtures and develops positive symbiotic relationships with and between its hinterland (regional, national or international)
- strive towards local and regional self-sufficiency and take full advantage of and nurture local/regional food production, economy, power production, and many other activities that sustain and support their populations
- facilitate (and encourage) more sustainable, healthful lifestyles, and
- emphasize a high quality of life and the creation of highly liveable neighbourhoods and communities.

More specifically, according to the UNESCO Chair in Sustainable Urban Development for Asia and the Pacific, there are three key components (or pillars) of 'green urbanism' (12) that affect built environment sustainability, and closely interact. They are as follows:



- *Energy and materials* – comprising: embodied energy, material specification, supply chain integration, renewable energy solutions, energy sources and consumption, construction systems, prefabrication and recycling, energy efficiency, and resource management.
- *Water and biodiversity* – comprising: urban water management, water recycling and irrigation, urban landscape typologies, maximised ecosystem biodiversity, grey water recycling; storage of urban stormwater, climate change impact management, and waste management.
- *Urban planning and transport* – comprising: urban design, social sustainability, ecological city theory, health and walk-ability, mobility and public transport links, infrastructure, energy efficient buildings, mixed land use, housing affordability, reduced car dependency, and subdivision design.

In summary, green urbanism is a multi-disciplinary endeavour involving a wide range of specialists including planners, biologists, engineers, architects, sociologists, economists and environmentalists. The aim of the endeavour is to minimise environmental and psychological costs through every stage of the urban lifecycle (13).

METHODS AND CONCEPTUAL BACKGROUND

This exploratory paper is based on an international review of leading peer reviewed journals, in both technical and management fields. It draws on highly cited articles published between 2000 and 2011. The articles dealt with the adoption of green urbanism innovations in Australia. Content analysis was employed to understand the diffusion context in view of the conceptual framework, which is shown in Figure 1. The authors each independently allocated the themes arising in the literature to the activities and actors shown in Figure 1. Following this, the two sets of analysis were merged and triangulated to arrive at a consensus understanding of the nature of key determinants. An innovation system framework was used to understand adoption determinants. The Construction Product System framework reveals the relationships between key activities and actors involved in the creation of the built environment. The regulatory and institutional context shapes, and is shaped by, the supply network, project-based firms and projects, with the technical support infrastructure playing a similar role.

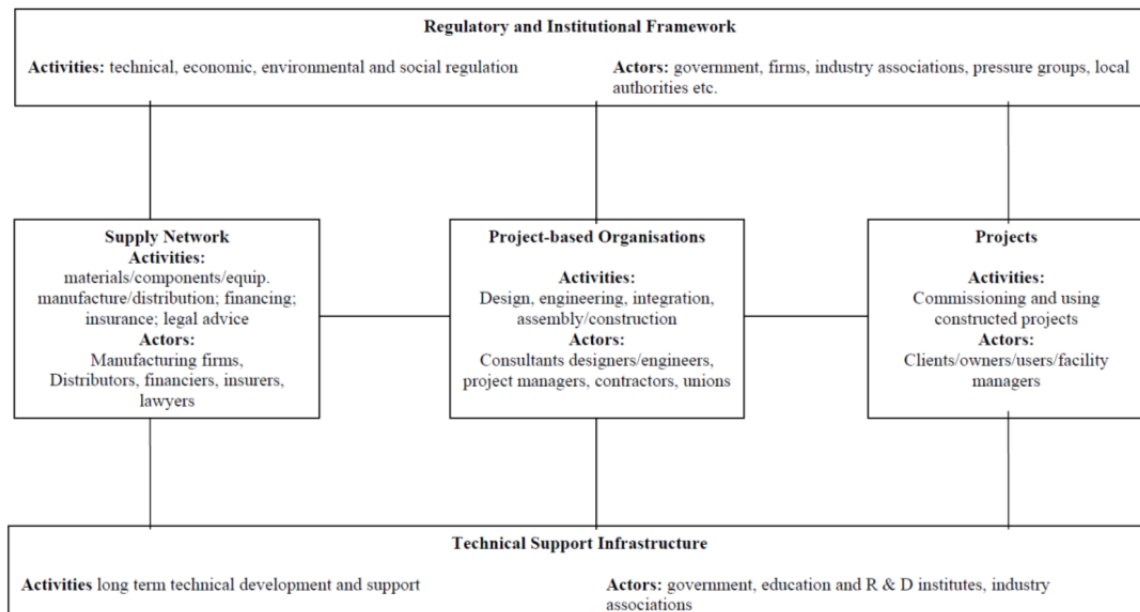


Figure 1 Activities and Actors in the Construction Product System (Source: based on Gann and Salter 2000)

The framework in Figure 1 emphasises the relationships and interdependencies in the built environment product system. Indeed, the project-based nature of production in the construction sector creates unique challenges to the adoption of innovation, compared to say, the manufacturing sector, for example. The temporary nature of teams makes it difficult to build up the strength of relationships often needed for successful innovation. In addition, the project to project production method implies a discontinuity which makes the accumulation of knowledge within project based firms difficult (4). These factors were predicted to play an important role in the adoption of green urbanism innovations. This was supported by the content analysis undertaken for the current study, guided by Figure 1 and reported below.

GREEN URBANISM INNOVATIONS – DISCRIPTION

There are a wide range of innovative global initiatives that are currently promoting the evolutionary changes required for green urbanism. The following discussion outlines a few examples that we consider to be particularly novel, and promising significant system-wide impacts.

Sustainable Buildings and Communities

Globally, it is estimated that over 70% of all greenhouse gas emissions originate from city buildings, and if changes do not occur in how the built environment industry procures and operates buildings, it is expected building energy consumption will triple by the year 2050 (20). To curb this trend, policy makers, planners and designers require an integrated sustainable approach to building developments that go beyond individual building design issues and products.



For example, sustainable community planning involves close connection between energy efficient housing integrated with community planning such as recycling schemes, public transport access, neighbourhood layout, and efficient use of public space (3). By placing emphasis on community development and public engagement in the design of new urban areas, a sustainable dynamic across an entire community can be encouraged. This is achieved by integrating sustainable buildings within an environment that optimises functionality and user satisfaction. Another aim is to provide opportunities for residents to make a cultural shift in their behaviour towards sustainable practices – such as sustainable transport and recycling programs.

Much sustainable community planning theory encourages ‘carbon-neutral communities’ that produce zero carbon dioxide (CO₂) emissions through efficient design and construction of buildings, infrastructure and operations (e.g. including on-site generation of renewable energy). According to research undertaken by RMIT on the development of carbon neutral communities in Australia, there is a need for a large research effort to realise the potential for carbon neutral communities and a requirement for further development of new technology to offset CO₂ emissions (10).

One step in this direction is the development of new city Master Planning technology which is improving how buildings interact within an urban environment and can assist planners in balancing social, environmental and economic parameters. One such technology is virtual city modelling (an expansion on individual building modelling) that can be used to assist in predicting the implications of future planning decisions on the urban form and function; and measure long-term energy use (20).

Urban Informatics

Currently, 50% of the world’s population live in cities and it is expected this will increase to 80% by 2050 (19). Due to increasing urbanisation, planning will play a critical role in shaping the urban environment to cater for these changes. Urban informatics assist urban planners in creating spaces that improve human habitat within the urban environment. This new approach includes the use of advanced information technology and mobile communication systems to monitor real-time ‘performance’ of a city and improve levels of interactivity between humans and the urban environment. This interaction is founded in the principles of urban informatics.

Urban informatics has emerged as a significant area of research over the past few years, requiring input from a wide range of disciplines, including information technology, social science, and built environment design (21). The premise behind urban informatics is that cities are living organisms and function with the rapid flow of information and communication across a wide range of infrastructure and social networks (6). Analysis of the ‘urban anatomy’ requires real-time research methods that integrate not only the levels of a city’s infrastructure, but also provide meaning to how the various anatomic systems interact and the interrelationships that are formed beyond its physical elements. This comprises the analysis of information and communication networks, or what can be coined the ‘city of bits’



(14), and most importantly, the interaction of city residents introducing socio-cultural factors to the study of the urban environment (6).

It is this interactive environment between people, place and technology that offers significant potential for innovation. Not only does technology offer innovative ways to communicate, interact and way-find (positioning) in the urban environment, but it can also assist in urban sustainability, such as information linkages between renewable energy producing devices.

Urban informatics also includes the potential development of 'digital cities', where software and hardware is used to simulate urban environments through 3D visual interfaces; and provides city residents with a virtual space to conduct business or socialise (6). A further advancement is the concept of 'city augmentation', combining both the physical built environment with a 'virtual' built environment to improve urban efficiency. Such technological advancements offer significant opportunities in the evolution of cities in coping with environmental changes in Australia and internationally.

GREEN URBANISM INNOVATIONS – SYSTEM DYNAMICS

The application of green urbanism principles across the entire Construction Product System offers long-term social and economic benefits, and at the global level, can contribute to the agenda for environmental sustainability and combating climate change. In reference to Figure 1, these initiatives (in their fully integrated form), are designed to impact all the key activities and actors in the Construction Product System. Sustainability innovations that integrate urban spaces across global, regional, city, precinct, building and building component levels are currently driven by 1) material, component and equipment manufacturing; 2) technical and environmental regulations; and 3) design, construction and urban planning practice.

A key element of the promotion of green urbanism in the built environment is the interest and relevant knowledge of the project-based actors. Project-based actors at the development level provide the expertise to integrate complex environment systems that determine optimal 'green design' solutions. Design coordination between project-based firm actors such as architects, engineers, contractors and urban planners is currently a key challenge in promoting green urban development, but is essential. Local government authority actors tasked with urban area planning play a key role in this coordination process, particularly providing the linkages between building and infrastructure system integration.

Support infrastructure actors (such as education institutes and industry associations) are assisting in advocating the benefits that can be achieved through green urbanism and sustainable development. They are targeting awareness and education campaigns to a range of actors, with particular emphasis on clients and developers. One successful example of this is the recently released *EnviroDevelopment* system, produced by the Urban Development Institute of Australia (UDIA). This system aims to educate planners and designers on the holistic assessment process required for the promotion of sustainability principles in new residential sub division development (17). Similarly, with the development of emerging urban modelling technologies by R&D institutes, urban planners and designers have greater



confidence in the efficiency of their proposed urban design solutions. Such systems also have an impact on end-product actors (government/private owners and users), as they provide the tools for the ongoing monitoring of urban design efficiency. For example, urban informatics offers great potential to improve the integration between people, place and technology in urban areas.

GREEN URBANISM INNOVATIONS – DIFFUSION ISSUES

A major barrier to the implementation of innovations that promote green urbanism is a lack of training for government and private developers on the need (and benefits that can be gained) from sustainable development. According to Horne, Bates et al. (10), legislative and economic instruments are powerful change promoters when applied in a consistent manner; however, the ‘persuasive nature of carbon-based lifestyles and work practices in Australia demands additional strategies based upon education, capacity-building and encouragement of voluntary measures’ (p.7).

Technical support infrastructure actors have a major role to play in these processes, particularly education institutes and industry associations. Although many educational programmes in Australia are promoting sustainability at the individual development level, improved coordination across all actors in the Construction Product System is required to overcome the barriers to uptake.

At the supply network and project-based firm level, current factors that are influencing the levels of uptake include demand for market share and shareholder perceptions towards green initiatives. Government policy on green energy generation and carbon trading schemes are key initiatives promoting change in demand and perceptions (10). Also, barriers to client/consumer acceptance of sustainable practices include perceived opportunity costs, convenience, reliability and maintenance cost, social status, perception of inferior products, and short-term views on cost-effectiveness (10).

In addition, there is currently a need to develop further understanding of the ‘cultural’ barriers to the uptake of green urbanism and sustainable development specifically from an Australian perspective (15). As human behaviour is shaped by the norms and values of communities, it is expected that responses to various community engagement and education initiatives will require a unique approach to adapt Australian attitudes and cultural norms.

Finally, cost is a major barrier to the uptake of sustainable development in the Australian built environment. Pinnegar, Marceau et al. (16) recommend clients should take a ‘whole of life’ cycle analysis approach to the assessment of a built asset’s cost. This includes ‘estimating the cumulative environmental and social impacts of a building throughout its lifespan, from construction, to use, to demolition’ (p.27). Although investment in technologies that improve sustainability may cost more upfront, the long-term benefits (from an environmental, economic and social perspective) can offset such costs. However, investment structures should be set up in a way to promote the long-term benefits (and not just the economic ‘payback’ benefits) to all parties financing the upfront costs (16).



In response to environmental degradation and global warming, Australian governments can promote change through an integrated policy and research approach, i.e. tightening regulatory requirements for ‘technical’ sustainability action, and investing in research and education programmes to promote ‘behavioural’ sustainability. According to Kellett (11), the effectiveness of government policy to promote the transition to a more sustainable future in urban areas requires ‘innovation, negotiated partnerships with market-based utility suppliers, novel institutions and a willingness to innovate on the part of local authorities and developers... [and] above all, community support’ (p.395). Thus, it is critical that both the social and financial benefits of sustainable development and green urbanism are made obvious to all built environment stakeholders.

CONCLUSIONS

As a result of climate change, population growth, increasing levels of urbanisation and depleting natural resources, major challenges are faced by planners and policy makers in Australia to redefine the spatial connections that integrate growing urban areas across global, regional, city, precinct, building and building component levels. A key part of this challenge is in the diffusion of green innovation and technology within urban areas. Drawing on a synthesis of literature in urban planning and innovation management fields, this paper has profiled innovative global initiatives that are currently promoting the evolutionary changes required for green urbanism. These innovations were interpreted through the lens of the Construction Product System framework in order to identify the determinants of green urbanism innovation diffusion.

Results indicate the important role to be played by project-based actors at the development level to provide the expertise to integrate complex environment systems that determine optimal ‘green design’ solutions. Project-based actor interest and relevant knowledge in green design solutions and the design integration across architects, engineers, contractors and urban planners remains a key challenge in promoting green urban development. Additionally, results indicate local government authority actors tasked with urban area planning also play a key role in this integration process, particularly providing the linkages between building and infrastructure system integration. The research findings suggest a requirement to increase training for government and private developers on the need (and benefits that can be gained) from sustainable development initiatives.

Results also indicate the important role to be played in these processes by technical support infrastructure actors, particularly education institutes and industry associations. Although many educational programmes in Australia are promoting sustainability at the individual development level, improved coordination across all actors in the Construction Product System is required to overcome the barriers to diffusion. Additionally, there is an identified need to develop further understanding of the ‘cultural’ barriers to the uptake of green urbanism and sustainable development specifically from an Australian perspective. As diffusion of green innovations are shaped by individual and cultural norms and community values in Australia, it is expected that a tailored approach to community engagement and



education initiatives is required to suit this specific context. Finally, the results suggest Australian governments need to be promoting change in the green urbanism space by possibly tightening regulatory requirements for ‘technical’ sustainability action, and investing in research and education programmes to promote ‘behavioural’ change.

Given the significant breadth of the topic, it has been necessary to profile selected green urbanism innovations from across the full range available. This selection has been necessarily subjective, but is nevertheless based on the advice of subject matter experts. It is expected future research will be able to quantify the relative promise of the profiled innovations, but as a starting point, this paper has mapped the innovation system dynamics surrounding the diffusion of key emerging innovations. Future empirical research is planned to build on these exploratory findings and further quantify the barriers to the wider diffusion of green urbanism innovation in the Australian built environment.

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